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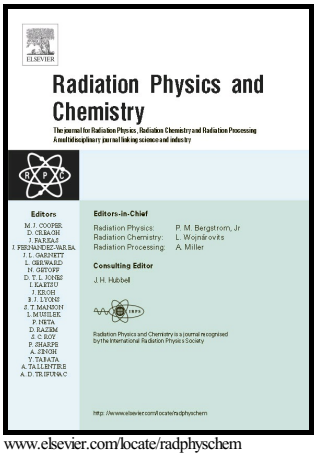


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# Carbon nanoparticles as possible radioprotectors in biological systems

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Abstract

Ionizing radiation causes radiolysis of water and the production of reactive oxygen species (ROS), which interact with biochemically important molecules in cells leading to cell death. In order to reduce the dangerous radiation effects on cells, tissues and organs, the search for radioprotectors is essential. ROS result in damage to biomolecules, e.g. proteins, lipids and DNA, and as a consequence, cause the loss of cell function. The chemical and biological properties of fullerenes and other carbon nanoparticles enable the possibility of generating either oxidative stress or its attenuation by both scavenging free radicals and modification/upregulation of endogenous antioxidative systems in cells. This study discusses the possible applications of carbon nanoparticles as radioprotective agents and/or free radical scavengers. Special attention is paid to water-soluble fullerenes as they are promising radioprotectors and exhibit low toxicity and cytotoxicity.

Abbreviations: ADH, alcohol dehydrogenase; BSA, bovine serum albumin; $C_{60}$HyFn, hydrated $C_{60}$ fullerene; CNTs, carbon nanotubes; DF-1, dendro[$C_{60}$]fullerene-1; DRF, dose reducing factor; DSBs, DNA double-strand breaks; DU145, prostatic adenocarcinoma cell line; ESR, electron spin resonance; γH2AX, phosphorylated histone H2AX; GO, graphene oxide; GPx, glutathione peroxidase; GSH, reduced glutathione; IC50, half maximal inhibitory concentration or dose required to kill half of the cells; LDH, lactate dehydrogenase; LET, Linear Energy Transfer; MDA, malondialdehyde; MWCNTs, multi-walled carbon nanotubes; NDs, nanodiamonds; PBLs, peripheral blood lymphocytes; MiaPaCa2, pancreatic adenocarcinoma; PBMCs, peripheral blood mononuclear cells; ROS, reactive oxygen species; RNS, reactive